October 9, 2014

Mr. Lenny Branch
Public Works Director
Town of Smithfield, North Carolina
P. O. Box 761
Smithfield, North Carolina 27577

Re: Report of Pavement Evaluation
Venture Drive
Smithfield, North Carolina
GeoTechnologies Project No. 1-14-0692-EA

Dear Mr. Branch,

GeoTechnologies, Inc. has completed the authorized evaluation of pavement and subsurface conditions on Venture Drive between Peedin Road and Industrial Park Drive in Smithfield, North Carolina. The purpose of this report is to present the findings of our field and laboratory investigation and to make recommendations for rehabilitation of the pavements at the site.

OBSERVATIONS

Venture Drive is a three lane road with the center turn lane. The total length of the road is approximately 2400 feet. The road is approximately 16 years old. Traffic at the site consists primarily of automobiles with some heavy trucks, construction type traffic and light delivery trucks. The actual traffic breakdown is not presently known to us.

The majority of the distress consists of medium to high severity alligator cracking (load induced distress) and is located in the north and south bound lanes. The center turn lane is relatively free of load induced distress but does contain some thermal and oxidation related shrinkage cracking. Rutting in the road is also relatively minor.

The alligator cracking is a result of overstressing the pavement base or subgrade by heavy traffic. The shrinkage cracking is the result of aging (oxidation) of the pavements over time. It is not unusual for alligator cracking to form along the shrinkage cracks as water weakens the base material beneath the crack. Some water stains were observed along cracks in the pavements but were not significant.

We did not perform a Pavement Condition Index (ASTM D-6433) study on the pavements at this site; however, based on our experience with the PCI system, the pavements at this site would be classified as poor. The pavements are still functional in terms of use by traffic; however, over time the distress will likely progress to potholes and increased rutting.

A total of 10 pavement borings were made at the site. The asphalt was cored with a diamond impregnated coring bit and the thickness of the asphalt and stone base were recorded. A Corps of Engineers dynamic cone penetrometer was used to evaluate the consistency of the subgrade soils and to determine in-place CBR values. Borings were advanced to a depth of approximately 2 to 3 feet below the pavement surface. Representative samples of the subgrade soils were retained for visual classification and laboratory tests. All borings were patched upon completion. Boring summaries may be found on Table 1 in the attachments to this report.

TEST BORINGS

Thickness of the asphalt pavement ranged from 2.9 to 4.0 inches with an average thickness of 3.5 inches. The asphalt was placed in two lifts. The asphalt is underlain by crushed aggregate base course stone (CABC). Thickness of the CABC ranged from 6.5 to 10.5 inches with an average thickness of 8.1 inches. The thinnest stone was found at borings B-1 and B-2. The aggregate base course stone was damp in the borings. Water was encountered at a depth of 36 inches at boring B-1. No water was observed in the other borings.

The subgrade soils consist primarily of moderately to highly plastic sandy clays and sandy silts with Unified Soil Classifications of CL, ML, CL-ML and CH. Subgrade CBR values ranged 2 to 14 percent. Only two values exceeded 5 percent.

LABORATORY TESTS

Laboratory testing included grain size analysis (ASTM D-1140) and natural moisture content (ASTM D-2216). Results are included in a summary on Table 2 in the attachments.

Natural moisture content tests performed on samples from the subgrade elevation ranged from 11.3 to 23.7 percent with an average moisture of 16.4 percent. Most of the moisture contents appear to be visually above optimum moisture content for the sandy clays found at this site. Liquid limits ranged from 20 to 36 percent with plasticity indices ranging from 3 to 18.

Representative samples of the aggregate base course stone and soil from the site were combined and treated with Portland cement at rates of 4, 7 and 10 percent by dry weight of materials. The blend of aggregate base course stone and soil was equivalent to approximately 7 inches of aggregate base course and 3 inches of soil. The materials were blended and compacted in accordance with ASTM D-558. The compacted samples were cured in a moist condition for seven days and were then tested for compressive strength. Compressive strengths obtained on the samples were 138 psi at 4% cement, 224 psi at 7% cement, and 346 psi at 10 percent cement.

STORM DRAINAGE ISSUES

The catch basins along the street were observed to be holding water. The top of the water varied from 15 to 40 inches from the top of the basin grates. A review of as-built plans from the

original construction shows that the elevation of the stormwater ponds at the site is higher than the invert elevations of most of the catch basins.

RECOMMENDATIONS

The following recommendations are made based upon a review of the attached test boring data, our understanding of the proposed construction, and past experience with similar projects and subsurface conditions. Should subsurface conditions adverse to those indicated by this report be encountered during construction, those differences should be reported to us for review and comment.

The overall condition of the pavements at this site is poor. The extensive alligator cracking indicates a loss of stability in the base and/or subgrade soils. While the pavements are still serviceable, levels of distress will likely increase until pothole development and rutting become significant enough to impact traffic. The high water levels in the storm water system may be impacting the distress in the pavements; however, it is likely that seasonal wetting and drying of the subgrades is a more significant contributor than issues in the storm drain system. If the conditions in the stormwater system were the major factor in the distress issue, then water should have been present in more than one test boring. Based on tests performed at the site, our observations and experience with similar conditions at other sites, we are recommending that following rehabilitation options for this site.

Option 1 – Complete Reconstruction

Complete reconstruction of the pavements on this road is possible; however, this option will require that all of the existing asphalt and stone base be removed from the road followed by undercutting of soft soils to a certain depth. This option could actually be impacted by the flooding of the existing storm water system. Backfill of the undercut sections would likely require replacement with expensive select granular materials with geogrids in order to establish a stable base for the support of pavements. The depth of undercut would likely be on the order of 2 to 3 feet from the top of existing pavement.

Option 2 - Full Depth Reclamation (FDR)

Complete reconstruction of the pavements as described above is the most expensive option for this site. An alternative to complete reconstruction is full depth reclamation of the pavements. This operation involves milling the existing asphalt off the road followed by mixing the existing base course stone and a portion of the subgrade soils with Portland cement to form a stabilized base course. The advantage of this option is that it utilizes existing materials and provides a base material that is far less susceptible to moisture than untreated bases. In this particular case, the process also treats the top 3 inches of subgrade soil which is sufficiently soft to impact the pavements. Once the FDR is completed, the road would be overlaid with asphalt. The cost of the stabilization process is approximately 25 to 35 percent less expensive than cut out and replacement and is also less expensive than large scale full depth patching. There are several contractors in the Triangle that can perform this

work. The cement would be mixed at a rate of 6.5 percent by dry weight of materials or 64 pounds of Portland cement per square yard per 10 inch depth. The entire road can be treated in this manner or only the travel lanes can be treated since the center turn lane does not exhibit the level of distress observed in the travel lanes. The following process is recommended for this operation.

1. Mill 3.5 inches of existing pavement and base course stone from the north and south bound lanes of the roadway. The center turn lane will not be milled.
2. Mix the recommended amount of Portland cement to a depth of 10 inches. Compact the material to a minimum of 97 percent of the maximum dry density as determined by ASTM D-558/ D-698.
3. Regrade the stabilized base to a uniform grade across the section. Proofroll the section with a loaded tandem axle dump truck. Any areas which are not stable should be remixed with additional cement.
4. After compaction is complete, construct a single bituminous surface treatment (SBST) over the treated base. The purpose of the SBST is to provide a curing seal for the treated base and to also provide a crack relief layer for shrinkage cracking that could occur in the treated base material. Traffic can run on the treated material until paving is performed.
5. The asphalt section will consist of 2.5 inches of I19.0B intermediate binder and 1.5 inches of S9.5B surface mix.
6. We have included a sample bid form for the FDR process in the attachments to this report.

GeoTechnologies, Inc. appreciates this opportunity to be of service to the Town of Smithfield. If you have any questions concerning this submittal, please do not hesitate to contact us. We will be glad to meet with you to discuss any questions you might have regarding rehabilitation of the road.

Sincerely,

GeoTechnologies, Inc.

David R. Harris
Senior Inspector

David L. Israel, P.E.
NC Reg. No. 14319

NORTH CAROLINA PROFESSIONAL SEAL 14319 ENGINEER DAVID L. ISRAEL

Attachments